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Path Co-efficient analysis for yield and yield attributing traits in bush type cowpea (*Vigna unguiculata* L.)

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Abstract

A study on direct and indirect effects of 11 quantitative characters of bush type cowpea through path analysis study on yield and its component traits had revealed that number of pods per plant, pod weight and 100 seed weight had the positive direct effect on green pod yield while the rest of the characters exhibited negative direct effect.

Keywords: *Vigna unguiculata* L., Direct effect, indirect effect

Introduction

Cowpea (*Vigna unguiculata* L. Walp.) popularly known as black eye pea is an annual, autogamous leguminous crop belonging to Fabaceae family commercially grown throughout India for its green pods and seeds. Cowpea is native to India (Vavilov, 1949) [11] but Tropical and Central Africa is also considered as secondary center of origin while wild races are also found even now (Ng and Marechal, 1985) [8]. It is having diploid chromosome number $2x = 2n = 22$ (Darlington and Wylie, 1955) [2]. Besides, used as green vegetable and food legumes, it is also used as green manure crop, cover crop and catch crop under a wide range of climatic condition in a particular country.

In India, sporadic breeding work on cowpea was started after 1970 under All India Coordinated Crop Research Programme (Jonoria and Ali, 1970 and Bapna *et al.*, 1972) [5, 1] and the achievements are limited. The released varieties cannot be continued longer due to genetic drift and influence of environment, pest and diseases in growing conditions. This demands replacement of old varieties by new developed ones.

Path analysis deals the close system of variable that are linearly related and specifies the cause and generally measures their relative importance, splitting the correlation coefficient into measures of direct and indirect contribution of various traits towards the yield.

Materials and Methods

Twenty genotype of bush type cowpea (*Vigna unguiculata* (L.) Walp.) were collected from different sources and subjected to evaluation at the Chatabara Research Station, Institute of Agricultural Sciences (SOA University), Bhubaneswar. It is observed that the soils of experimental plot comes under sandy loam (sand-73.14%, silt-15.61%, clay-11.25%) having pH 5.44. The genotypes were collected from different sources. The observations were recorded on five randomly selected plants per replication for each genotype on 11 quantitative characters. The direct and indirect effects were obtained by the method suggested by Dewey and Lu (1959) [3].

Results and Discussion

In order to find out the cause and effect relationship on yield per plant, path co-efficient analysis was carried out taking 11 quantitative traits in bush type cowpea. The correlation of fruit yield per plant with other characters were partitioned into component of direct and indirect effects that would reflect on the nature of these associations and relative importance of the components in determining fruit yield. The phenotypic correlation co-efficient was used in path analysis and the results (phenotypic path) are presented in Table 1.

Days to 50% flowering indicated positive direct effect (0.017) on pod yield per plant. The effect was mainly resulted by positive indirect effect via, plant height (0.001), number of branches per plant (0.004), days to edible maturity (0.006), number of pods per plant (0.050), pod length (0.006), pod weight (0.119), 100 seed weight (0.003) and pod girth (0.003). The indirect effect of number of seeds per pod (-0.002) were in negative directions. Plant height indicated positive direct effect (0.035) on pod yield per plant. The indirect effect such as days to 50% flowering (0.000), number of branches per plant (0.010), number of pods per plant (0.371), number of seeds per pod (0.001), pod weight (0.168) and pod girth (0.003) are in positive direction while rest of the characters like days to edible maturity (-0.000), pod length (-0.000) and 100 seed weight (-0.045) had indirect effect in negative direction. Number of branches per plant has negative direct effect (-0.025) on the pod yield per plant which was mainly contributed by indirect negative effects such as days to 50% flowering (-0.002) and pod girth in spite of positive direct effect via plant height (0.006), days to edible maturity (0.007), number of pods per plant (0.360), pod length (0.002), number of seeds per pod (0.011), pod weight (0.189) and 100 seed weight (0.042). Days to edible maturity has positive direct effect (0.083) on pod yield per plant. It is mainly contributed by indirect positive effect via, plant height (0.002), number of pods per plant (0.002), pod length, in spite of indirect negative effect via, days to 50% flowering (-0.019), number of branches per plant (-0.002) and number of seeds per pod (-0.012). Number of pods per plant had highest direct positive effect (0.672) with edible pod yield per plant. The highest direct contributed for this trait due to indirect positive effect via, plant height (0.018), days to edible maturity, pod length, number of seeds per pod (0.018) and 100 seed weight (0.015). On the contrary, indirect effect of days to 50% flowering (-0.001), number of branches per plant (-0.013), pod weight (-0.014) and pod girth were in negative directions. Pod length had positive direct effect (0.013) with pod yield per plant which is mainly due to indirect positive effect via, days to edible maturity (0.002), number of pods per plant, number of seeds per pod (0.021), pod weight (0.233) and 100 seed weight (0.033) whereas negative indirect effect for this was observed via, days to 50% flowering (-0.002), plant height (-0.001), number of branches per plant (-0.005) and pod girth. Number of seeds per pods had direct positive effect (0.049) on edible pod yield per plant. The indirect positive effect which were responsible for this resulted due to days to 50% flowering (0.003), plant height (0.011), number of pods per plant (0.249), pod length (0.005), pod weight (0.158) and 100 seed weight (0.017) which are having positive values. On the contrary, indirect negative effect via, number of branches per plant (0.006), days to edible maturity (-0.020) and pod girth were observed for this trait. Pod weight had the second highest positive direct effect (0.574) after number of pods per plant (0.672) on edible pod yield per plant. The indirect positive effect responsible for this result

were via, days to edible maturity (0.002), plant height (0.010), pod length (0.005), number of seeds per pod (0.013) and 100 seed weight (0.092). On the contrary, the indirect effect via, days to edible maturity (0.002), plant height (0.010), pod length (0.005), number of seeds per pod (0.013) and 100 seed weight (0.092). On the contrary, the indirect effect via, days to 50% flowering (-0.003), number of branches per plant (-0.008), number of pods per plant (-0.016) and pod girth are in negative directions. 100 seed weight had high direct positive effect (0.130) after pod weight (0.574) and number of pods per plant (0.672) in ascending order on edible pod yield per plant. The indirect positive effects which were responsible for this are plant height (0.004), days to edible maturity (0.017), number of pods per plant (0.077), pod length (0.003), number of seeds per pod (0.006) and pod weight (0.407). On the other hand indirect effect via, days to 50% flowering (-0.006), number of branches per plant (-0.008) and pod girth were in negative directions. Pod girth had direct negative effect (-0.001) on edible pod yield per plant which is mainly contributed due to indirect negative effect via, plant height (-0.003), number of branches per plant (-0.001) and days to edible maturity (-0.027) whereas positive indirect effect via, days to 50% flowering (0.003), number of pods per plant (0.065), pod length (0.004), number of seeds per pod (0.013), pod weight (0.186) and 100 seed weight (0.022) were observed.

From the phenotypic path, it is observed that number of pods per plant (0.672) had the highest positive direct effect followed by pod weight (0.574) and 100 seed weight on edible pod yield per plant in cowpea. Other traits such as days to edible maturity (0.083), number of seeds per pod (0.049), plant height (0.035), days to 50% flowering (0.017), pod length (0.013) also exhibited positive direct effect of lower magnitude. On the other hand, number of branches per plant (-0.025) and pod girth (-0.001) showed negative indirect effect of lower magnitude though they are having positive correlation with edible pod yield per plant.

From the above results of path analysis, it may be inferred that number of pods per plant, pod weight and 100 seed weight are three important yield contributing characters for green pod yield in cowpea. Further the occurrence of significant positive correlation coefficient between number of pods per plant (0.695), pod weight (0.670) and 100 seed weight (0.632) with green pod yield per plant (the effect) showing positive and direct effect 0.672, 0.574, 0.130 respectively explain the existence of real relationship of these characters in edible pod yield of cowpea suggesting selection through these three traits would be result oriented in bush type cowpea improvement programme. The present findings are in agreement with findings of Narayanankutty *et al.* (2003)^[7], Venketasan *et al.* (2003)^[14], Vineeta *et al.* (2003)^[12], Lal *et al.* (2007), Vishwanath *et al.* (2009)^[13], Kumari *et al.* (2012)^[6], Dinesh *et al.* (2017)^[4], Yadav *et al.* (2019)^[15], Panchta *et al.* (2020)^[9] and Snehal *et al.* (2021)^[10] in cowpea.

Table 1: Path coefficient analysis of direct (diagonal) and indirect effects of various traits on edible pod yield per plant at phenotypic level

Sl. No.	Characters	Days to 50% flowering	Plant height (cm)	No. of branches per plant	Days to edible maturity	No. of pods per plant	Pod length (cm)	No. of seeds per pod	Pod wt (g)	100 seed wt (g)	Pod girth (cm)	Correlation with edible pod yield per plant(g)
1	Days to 50% flowering	0.017	0.001	0.004	0.006	0.050	0.006	-0.002	0.119	0.003	0.003	0.214
2	Plant height (cm)	0.000	0.035	0.010	-0.000	0.371	-0.000	0.001	0.168	-0.045	0.003	0.507**
3	No. of branches per plant	-0.002	0.006	-0.025	0.007	0.360	0.002	0.011	0.189	0.042	-0.000	0.593**
4	Days to edible maturity	-0.019	0.002	-0.002	0.083	0.002	0.000	-0.012	0.018	0.027	0.000	0.101
5	No. of pods per plant	-0.001	0.018	-0.013	0.000	0.672	0.000	0.018	-0.014	0.015	-0.000	0.695**
6	Pod length (cm)	-0.002	-0.001	-0.005	0.002	0.000	0.013	0.021	0.233	0.033	-0.000	0.295*
7	No. of seeds per pod	0.003	0.011	-0.006	-0.020	0.249	0.005	0.049	0.158	0.017	-0.000	0.469**
8	Pod wt (g)	-0.003	0.010	-0.008	0.002	-0.016	0.005	0.013	0.574	0.092	-0.000	0.670**
9	100 seed weight (g)	-0.006	0.004	-0.008	0.017	0.077	0.003	0.006	0.407	0.130	-0.000	0.632**
10	Pod girth (cm)	0.003	-0.001	-0.001	-0.027	0.065	0.004	0.013	0.186	0.022	-0.001	0.264*

Residual effect=0.029

Figures in bold denoted the Direct Effect

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